

Low Impact Development Technology

Ecologically Functional Stormwater Management Technology

“Multi-functional site design, streetscapes and architecture that maintains and restores vital terrestrial ecologically processes necessary to protect the ecological integrity of our receiving waters”

“Lower Costs / Lower Impacts / Added Values”

Presented by:

**Larry S. Coffman
LNSB, LLLP Stormwater Services
301 580 6631**



Balancing Growth and Environmental Integrity

Advance Stormwater Technology

Pilot Projects

Research

Monitoring

Modeling

Manuals

Training

Education

The Low Impact Development Center

Neil Weinstein, Executive Director – Phone: 301.982.5559

<http://www.lowimpactdevelopment.org/>

Low Impact Development Overview

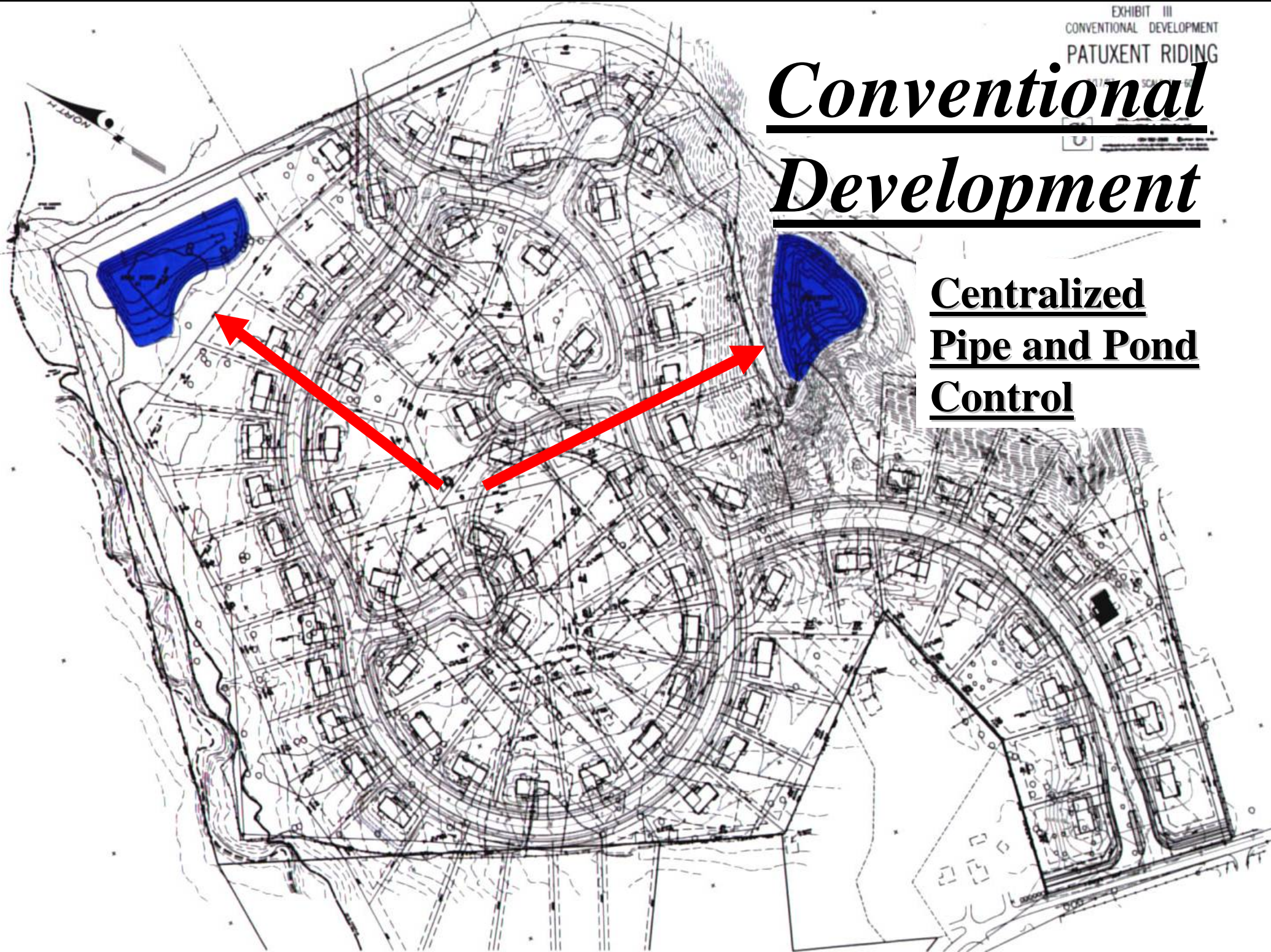
- **New Philosophy**
 - **Maintaining Functional Relationships Between Terrestrial and Aquatic Ecosystems**
 - **Keep Water Where it Falls**
- **New Principles**
 - **Decentralized / Source Control**
 - **Distributed / Multi-functional / Multi-beneficial**
- **Old Ideas / Practices / New Approaches**
 - **Retain / Detain / Filter / Infiltrate / Treat / Prevent / Use**
- **New Process**
 - **Conserve / Minimize / Timing / Integrate Practices / Prevent**

WHY IS LID SO ATTRACTIVE?

- Universally Applicable (Unique Water Balance)
- Economically Sustainable
- Ecologically Sustainable
- Added Values
- Lower Costs (Construction, Maintenance & Operation)
- Multiple Benefits (air / water / energy / property values)
- Silent on Growth Management
- Ideal for Urban Retrofit
- Common Sense Approach
- Public Acceptance

Conventional *Development*

Centralized
Pipe and Pond
Control

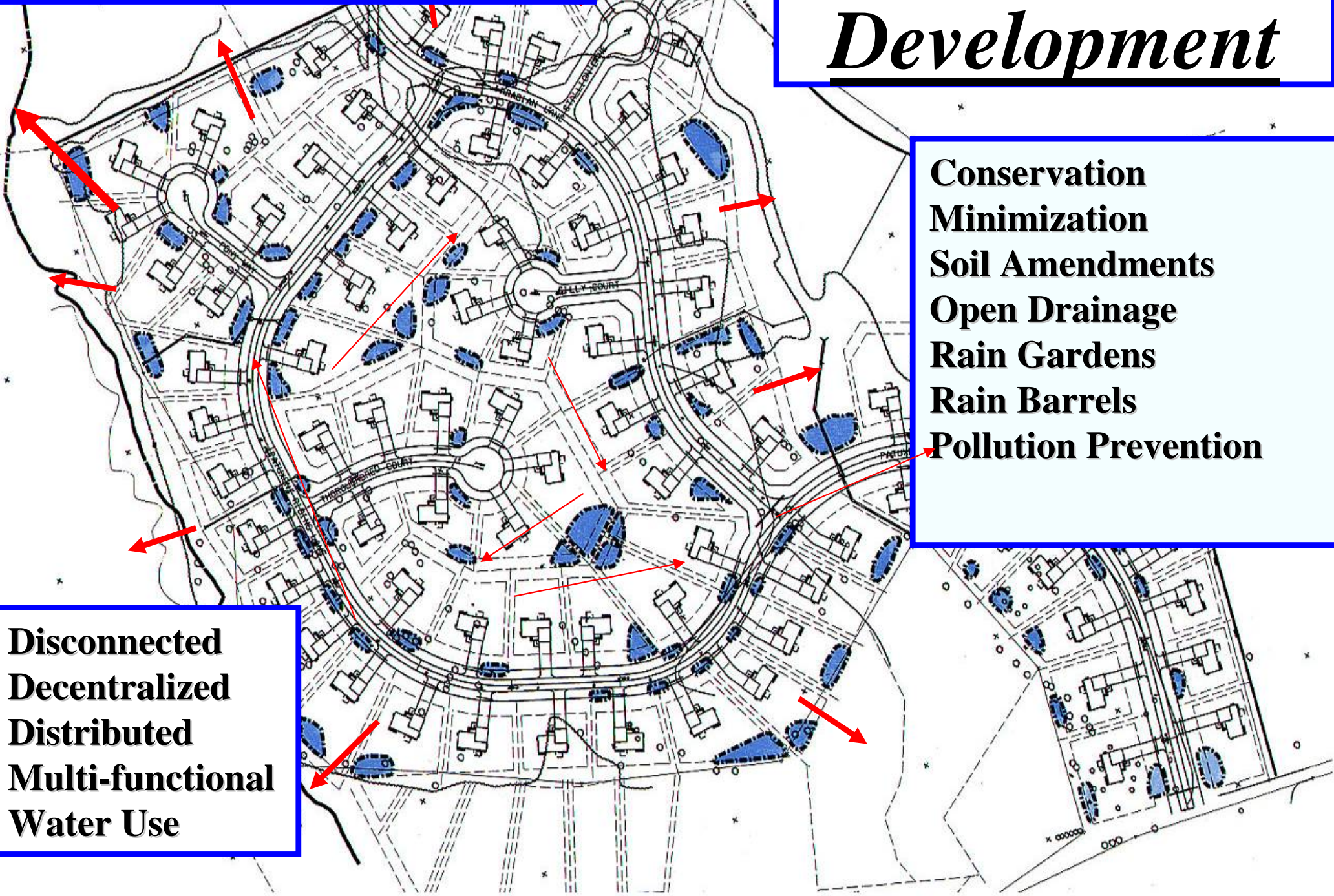


Multiple Systems

LID *Development*

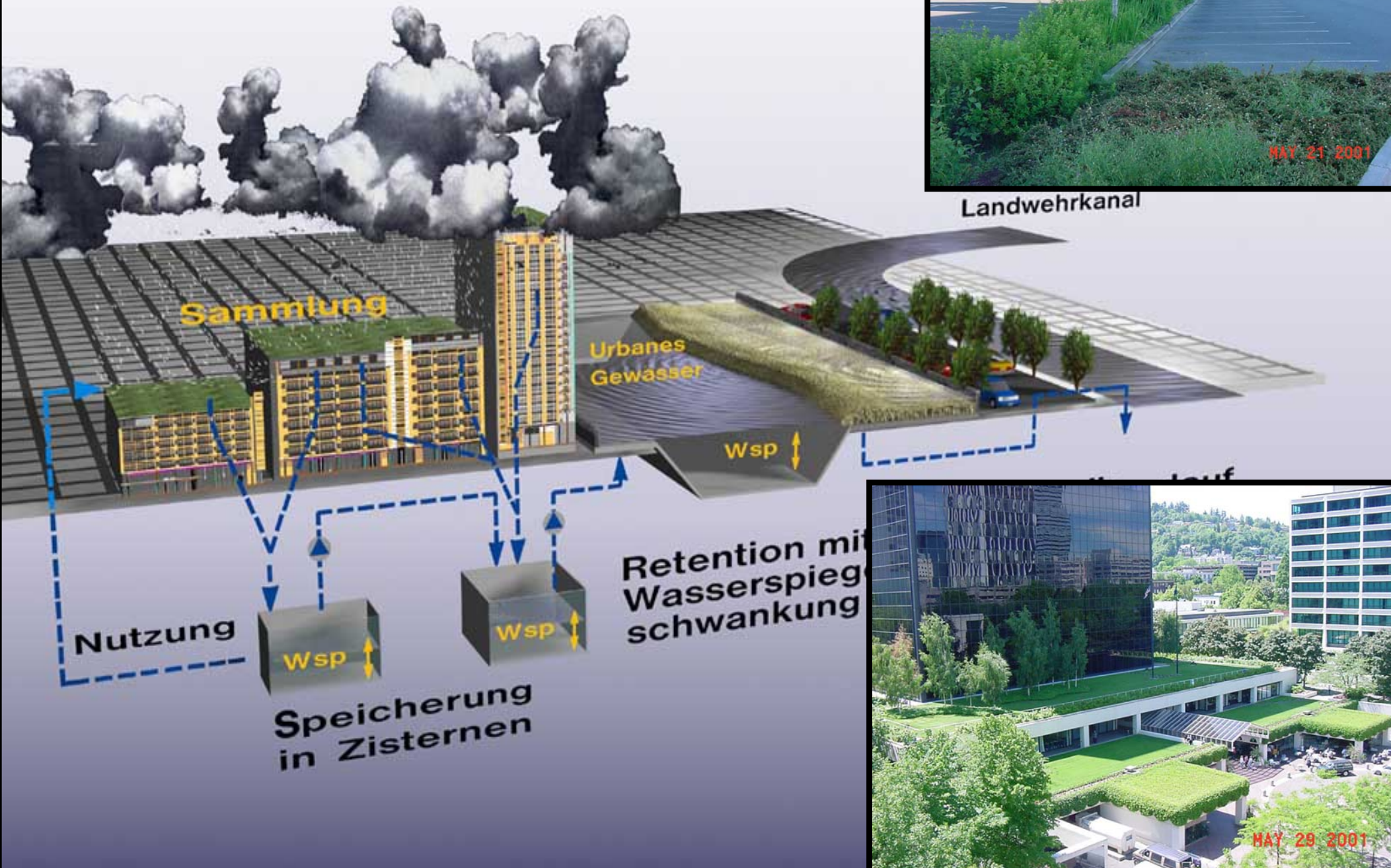
**Conservation
Minimization
Soil Amendments
Open Drainage
Rain Gardens
Rain Barrels
Pollution Prevention**

**Disconnected
Decentralized
Distributed
Multi-functional
Water Use**





Berlin Potsdamer Platz Regenwasse





Rain Gardens

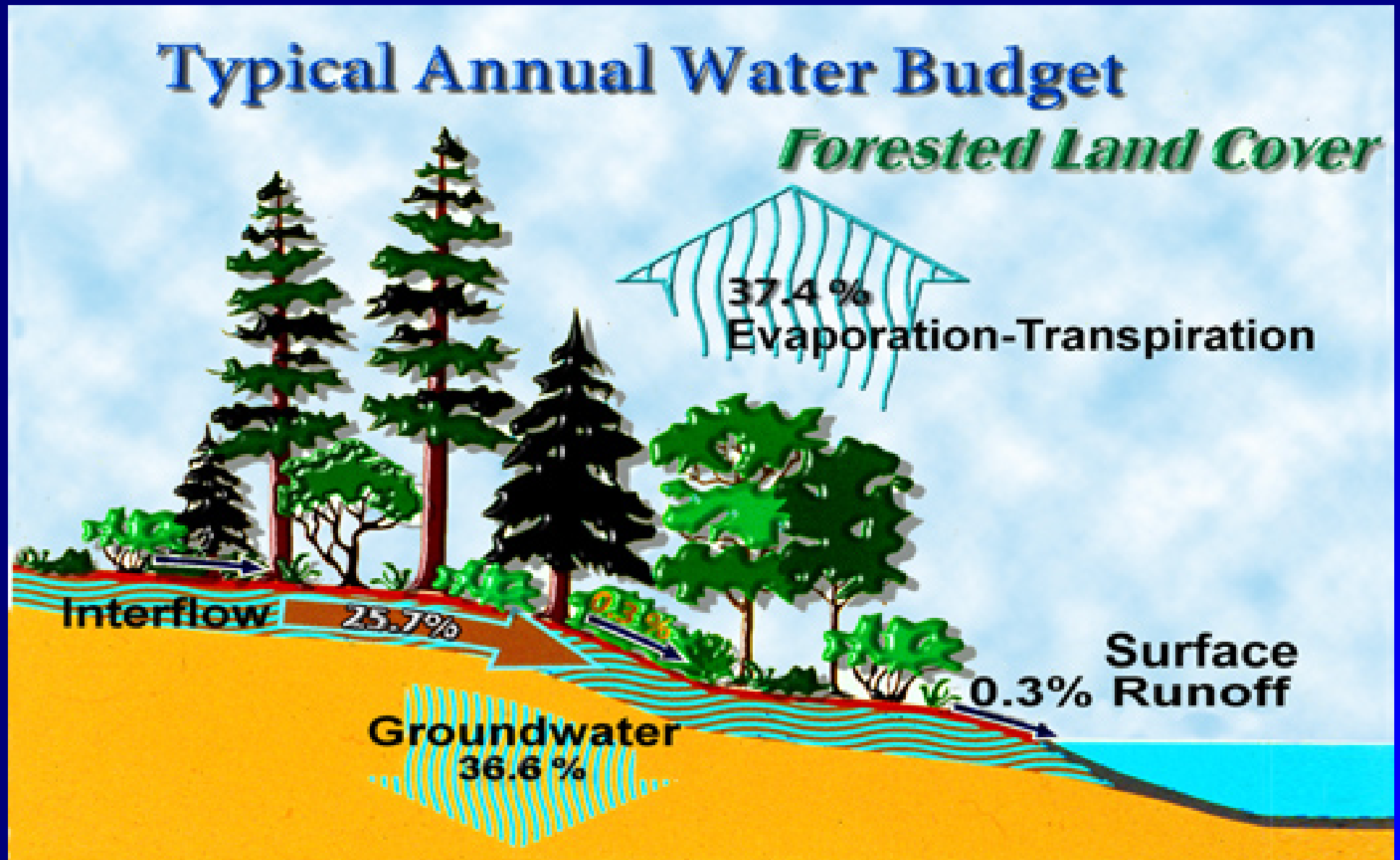


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The conventional methods alone do not work effectively.



Natural Conditions



The Problem: Conventional Site Design

*Collect
Concentrate
Convey
Centralized
Control*



Good Drainage Paradigm

*Hydrologically
Connected*



*Ecologically
Dysfunctional*

Get the water away as fast as possible!



LID Basics

Philosophy

Principles

Practices

Process

How Does LID Maintain or Restore The Hydrologic Regime?

- **Creative ways to:**
 - **Maintain / Restore Storage Volume**
 - **interception, depression, channel**
 - **Maintain / Restore Infiltration Volume**
 - **Maintain / Restore Evaporation Volume**
 - **Maintain / Restore Runoff Volume**
 - **Maintain Flow Paths**
 - **Water Use**
- **Engineer a site to mimic the natural water cycle functions / relationships**

Key LID Principles “Volume”

“Hydrology as the Organizing Principle ”

- **Unique Watershed Design**
 - Match Initial Abstraction Volume
 - Mimic Water Balance
- **Uniform Distribution of Small-scale Controls**
- **Cumulative Impacts of Multiple Systems**
 - filter / detain / retain / use / recharge / evaporate
- **Decentralized / Disconnection**
- **Multifunctional Multipurpose Landscaping & Architecture**
- **Prevention**

Defining LID Technology

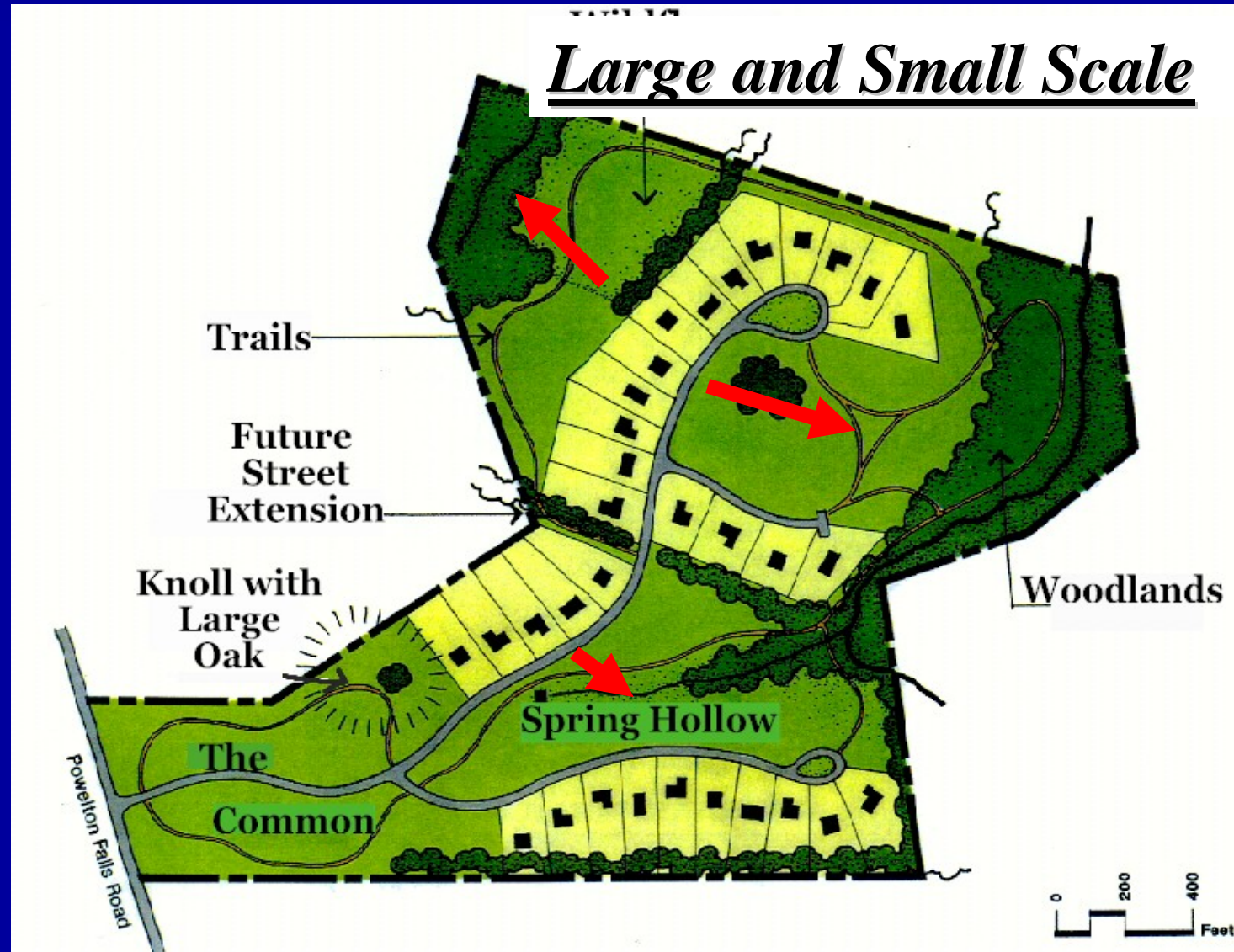
Major Components

1. Conservation (Watershed and Site Level)
2. Minimization (Site Level)
3. Strategic Timing (Watershed and Site Level)
4. Integrated Management Practices (Site Level)
Retain / Detain / Filter / Recharge / Use
5. Pollution Prevention
Traditional Approaches

1. Conservation Plans / Regulations

- **Local Watershed and Conservation Plans**

- Forest (Contiguous and Interior Habitat)
- Streams
- Wetlands
- Habitats
- Step Slopes
- Buffers
- Critical Areas
- Parks
- Scenic Areas
- Trails
- Shorelines
- Difficult Soils
- Ag Lands
- Minerals



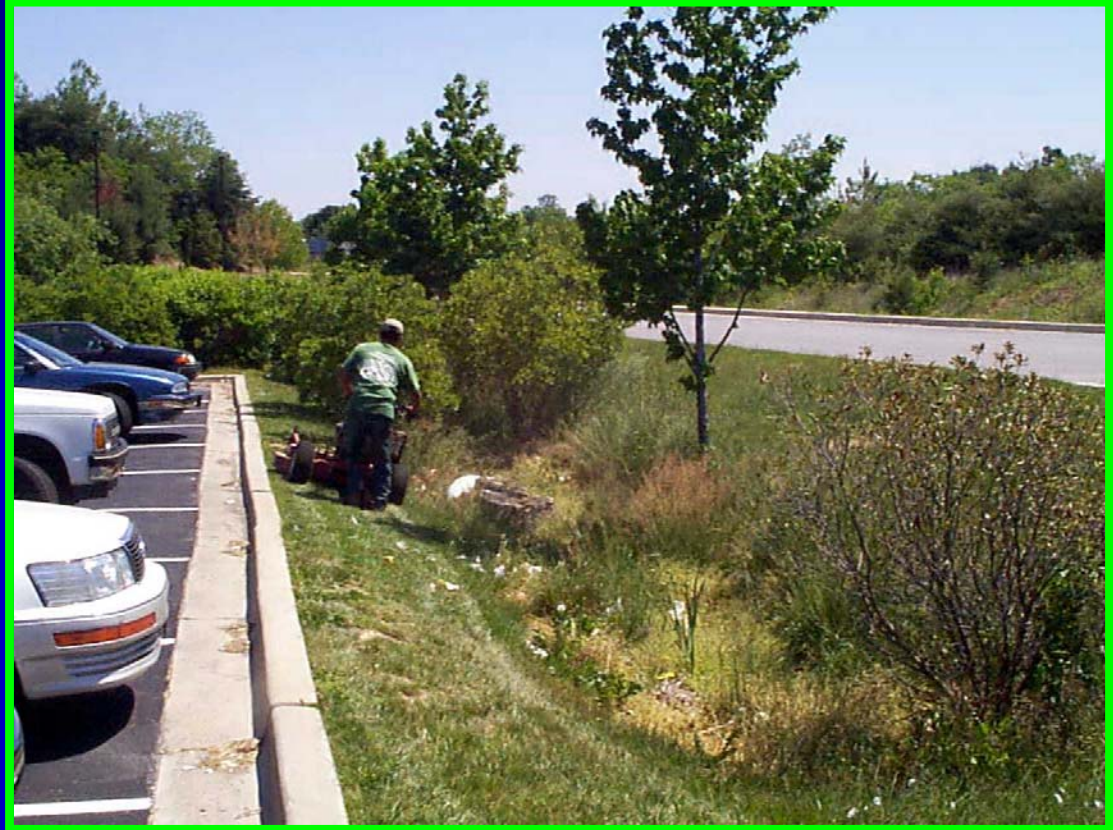
2. Minimize Impacts

- **Minimize clearing**
- **Minimize grading**
- **Save A and B soils**
- **Limit lot disturbance**
- *** Soil Amendments**
- **Alternative Surfaces**
- **Reforestation**
- **Disconnect**
- **Reduce pipes, curb and gutters**
- **Reduce impervious surfaces**



3. Maintain Time of Concentration

- **Open Drainage**
- **Use green space**
- **Flatten slopes**
- **Disperse drainage**
- **Lengthen flow paths**
- **Vegetative swales**
- **Maintain natural flow paths**
- **Increase distance from streams**
- **Maximize sheet flow**

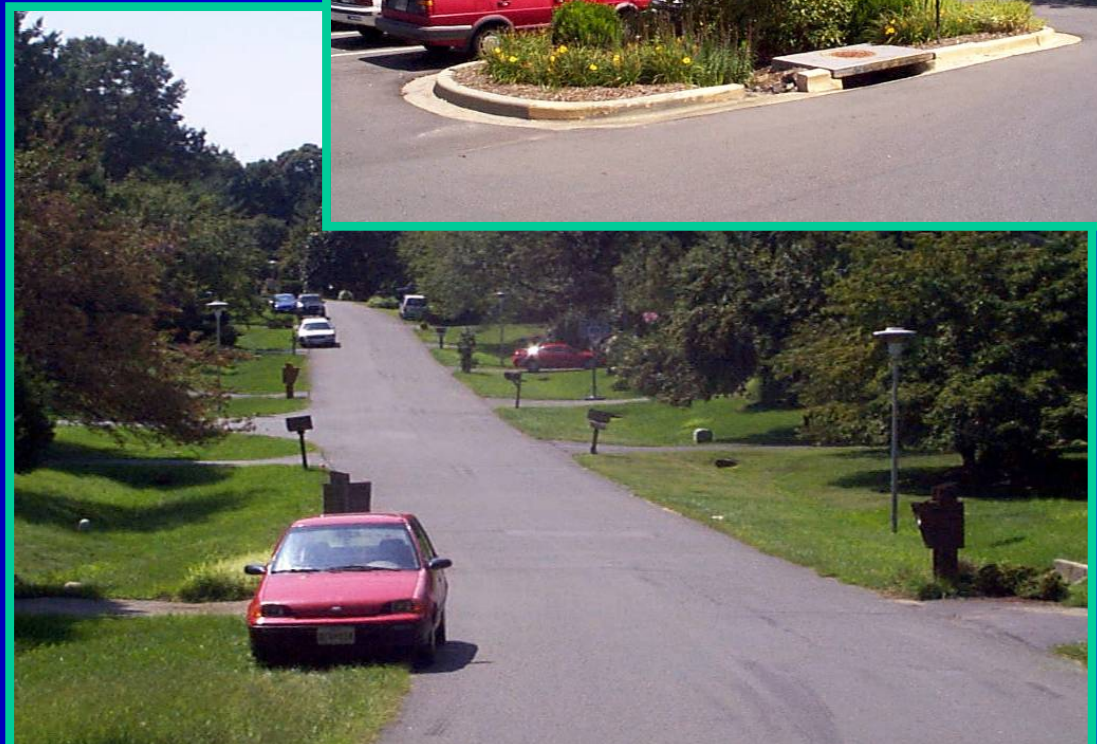


4. Storage, Detention & Filtration

“LID IMP’s”

- Uniform Distribution at the Source

- Open drainage swales
- Rain Gardens / Bioretention
- Smaller pipes and culverts
- Small inlets
- Depression storage
- Infiltration
- Rooftop storage
- Pipe storage
- Street storage
- Rain Water Use
- Soil Management**

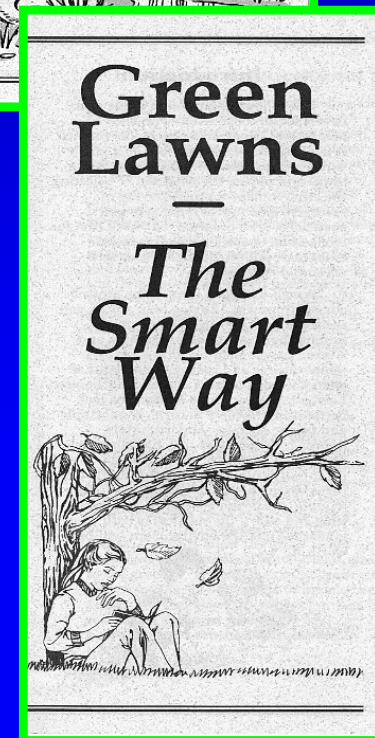
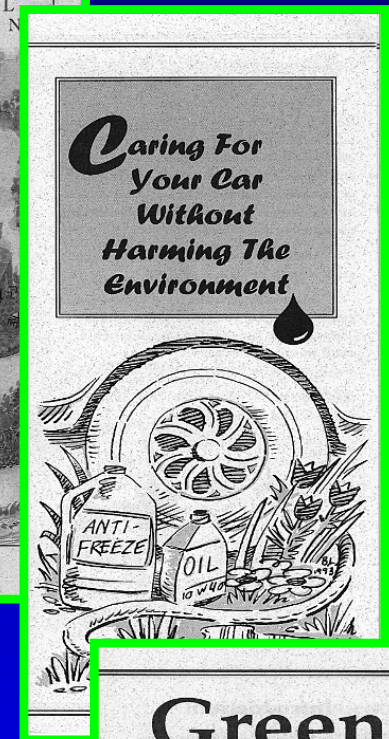
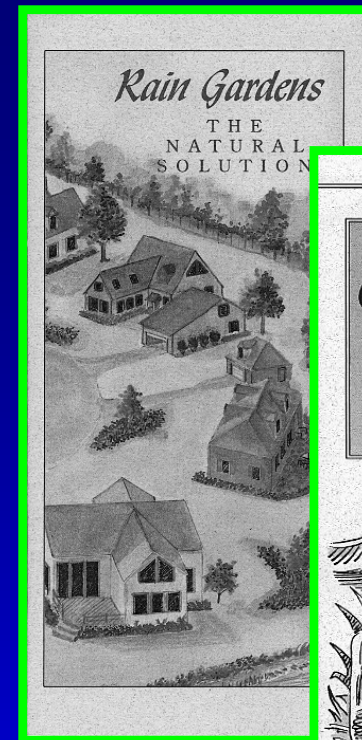


5. Pollution Prevention

30 - 40% Reduction in N&P

Kettering Demonstration Project

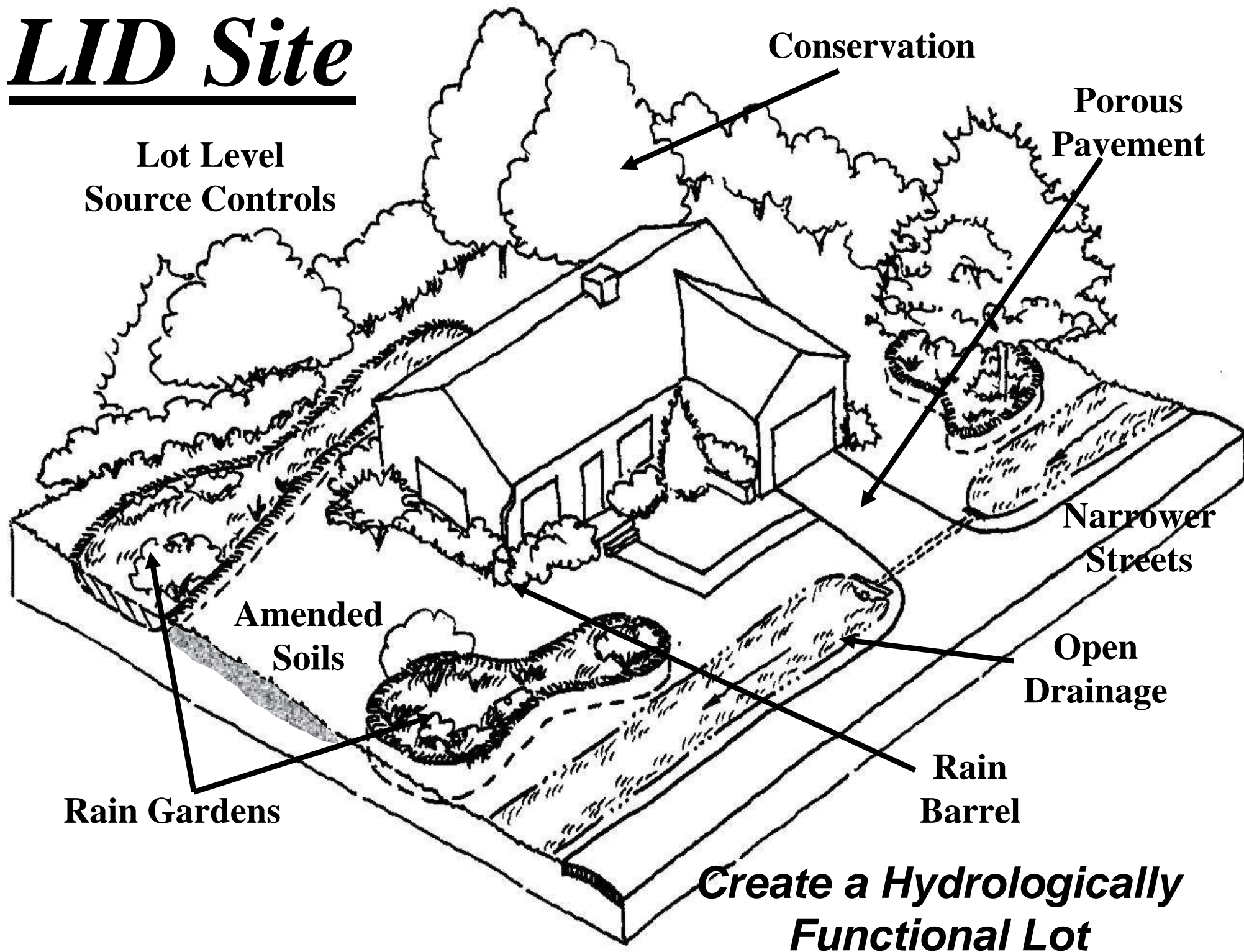
- Maintenance
- Proper use, handling and disposal
 - Individuals
 - Lawn / car / hazardous wastes / reporting / recycling
 - Industry
 - Good house keeping / proper disposal / reuse / spills
 - Business
 - Alternative products / Product liability



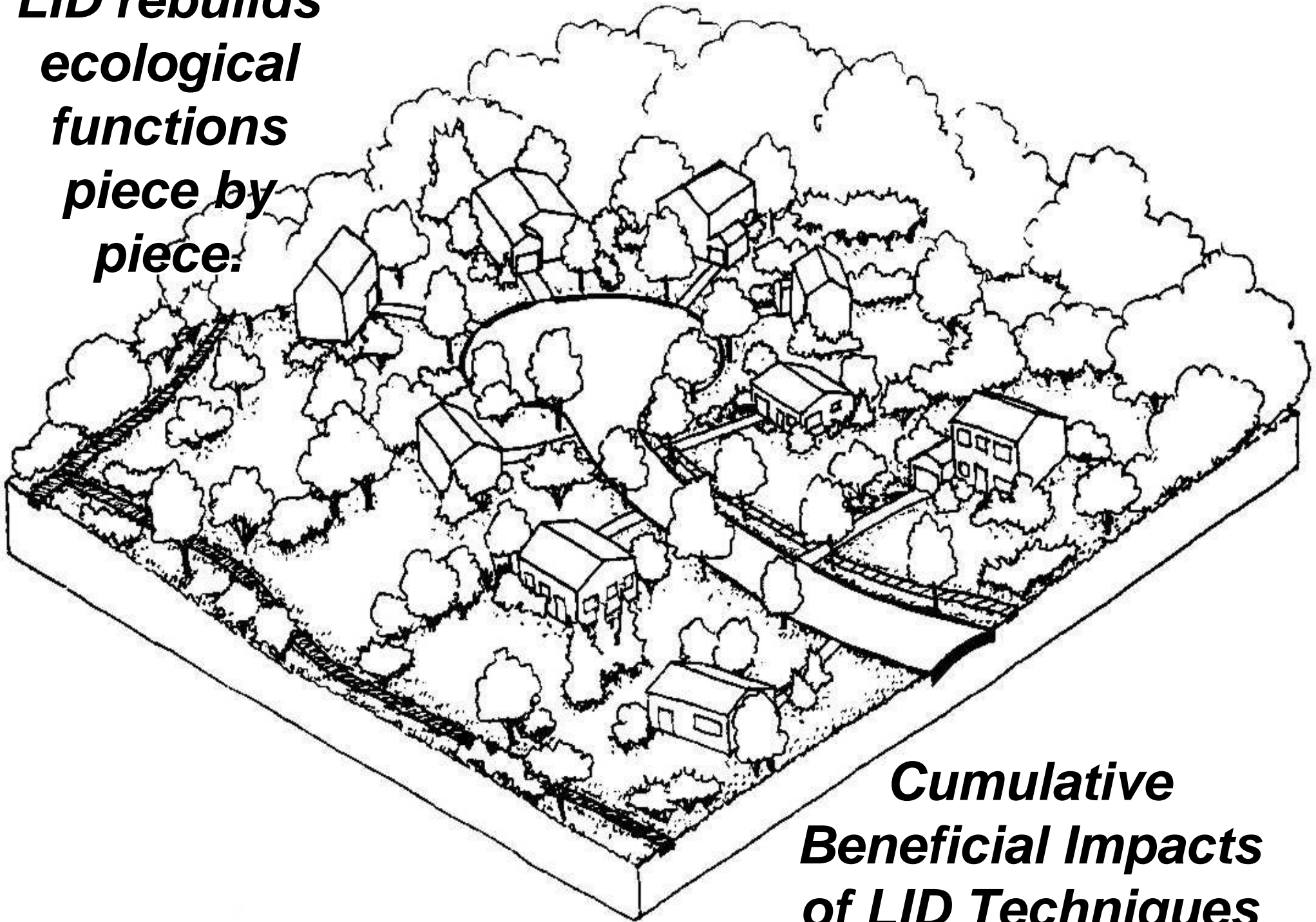
WATER
QUALITY
CONSORTIUM



LID Site



***LID rebuilds
ecological
functions
piece by
piece.***



***Cumulative
Beneficial Impacts
of LID Techniques***

LID Practices (No Limit!)

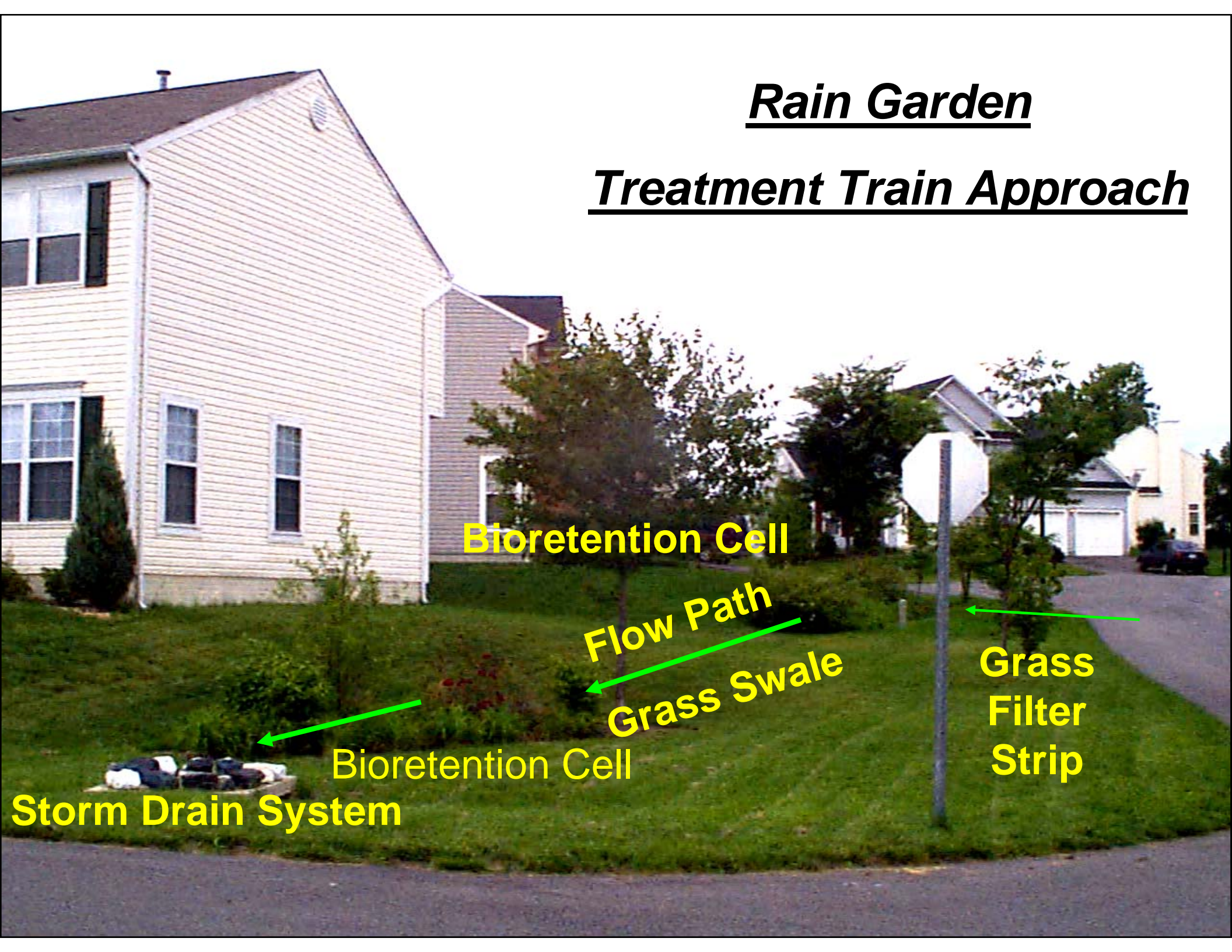
“Creative Techniques to Treat, Use, Store, Retain, Detain and Recharge”

- **Bioretention / Rain Gardens**
- **Strategic Grading**
- **Site Finger Printing**
- **Resource Conservation**
- **Flatter Wider Swales**
- **Flatter Slopes**
- **Long Flow Paths**
- **Tree / Shrub Depression**
- **Turf Depression**
- **Landscape Island Storage**
- **Rooftop Detention /Retention**
- **Roof Leader Disconnection**
- **Parking Lot / Street Storage**
- **Smaller Culverts, Pipes & Inlets**
- **Amended soils**
- **Alternative materials**
- **Tree Box Filters**
- **Alternative Impervious Surfaces**
- **Reduce Impervious Surface**
- **Surface Roughness Technology**
- **Rain Barrels / Cisterns / Water Use**
- **Catch Basins / Seepage Pits**
- **Sidewalk Storage**
- **Vegetative Swales, Buffers & Strips**
- **Infiltration Swales & Trenches**
- **Eliminate Curb and Gutter**
- **Shoulder Vegetation**
- **Maximize Sheet flow**
- **Maintain Drainage Patterns**
- **Green Roofs**
- **Reforestation**
- **Pollution Prevention.....**









Rain Garden

Treatment Train Approach

Bioretention Cell

Flow Path

Grass Swale

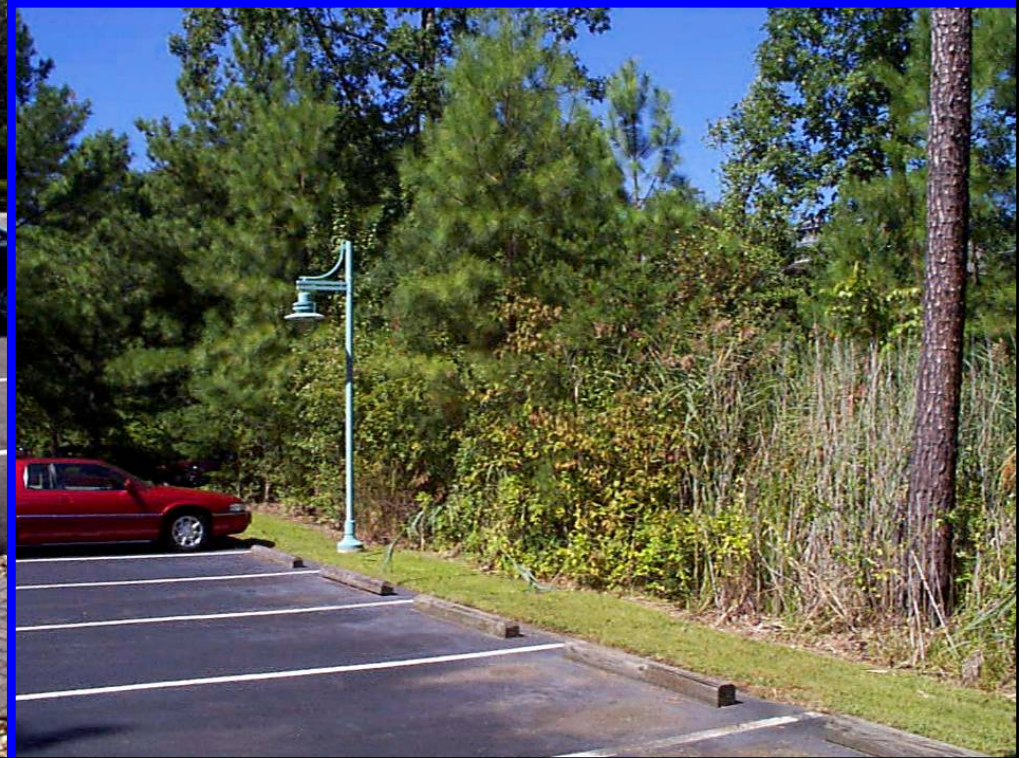
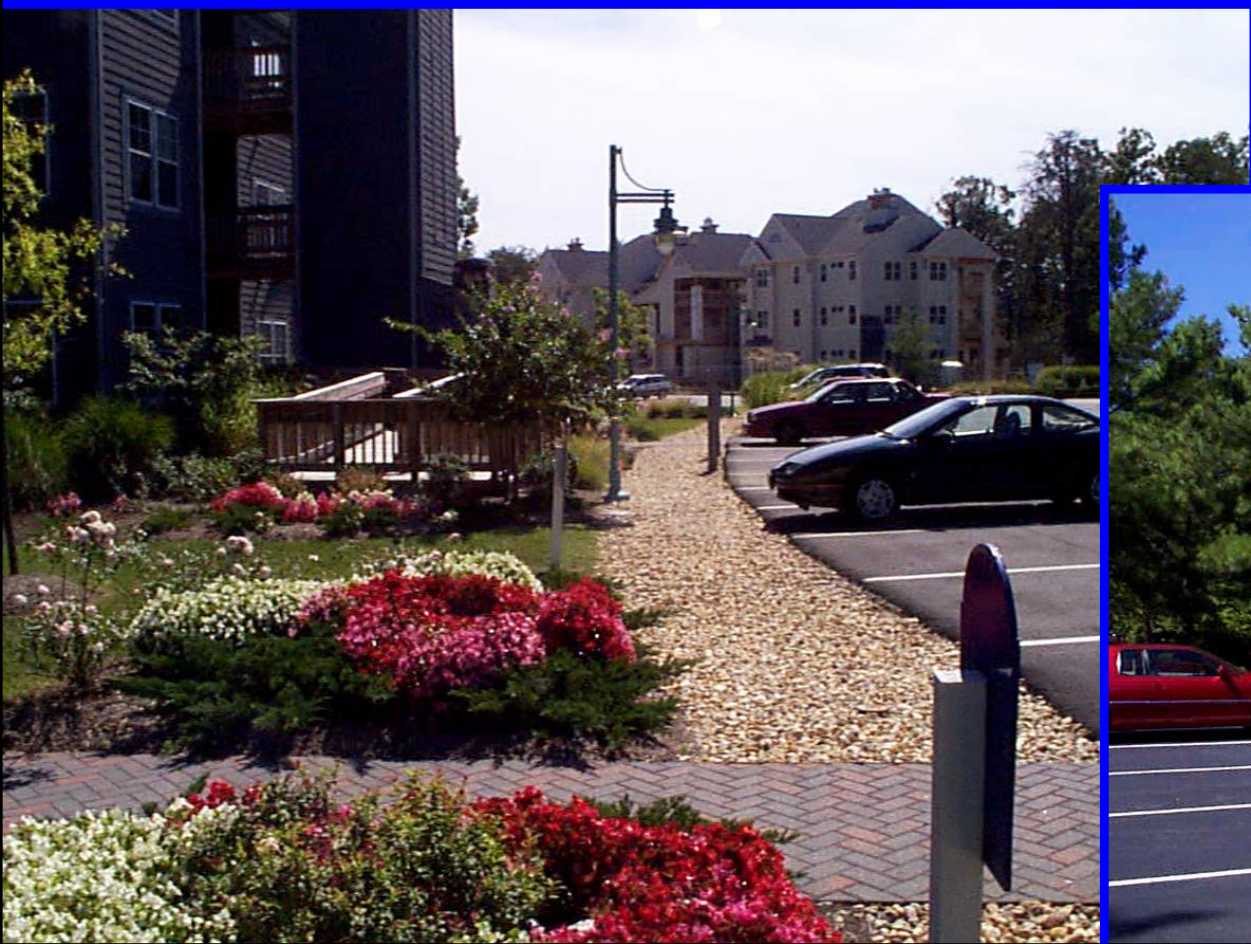
Grass
Filter
Strip

Bioretention Cell

Storm Drain System

VIEW OF LOT WITH STORAGE AND BIORETENTION





Rain is Resource

Capture & Use

Toilet Flushing
Car washing
Irrigation
Mixing
Washing
Gardening
Recharge

Benefits

Reduce Demand
Self-sufficiency
Save Money

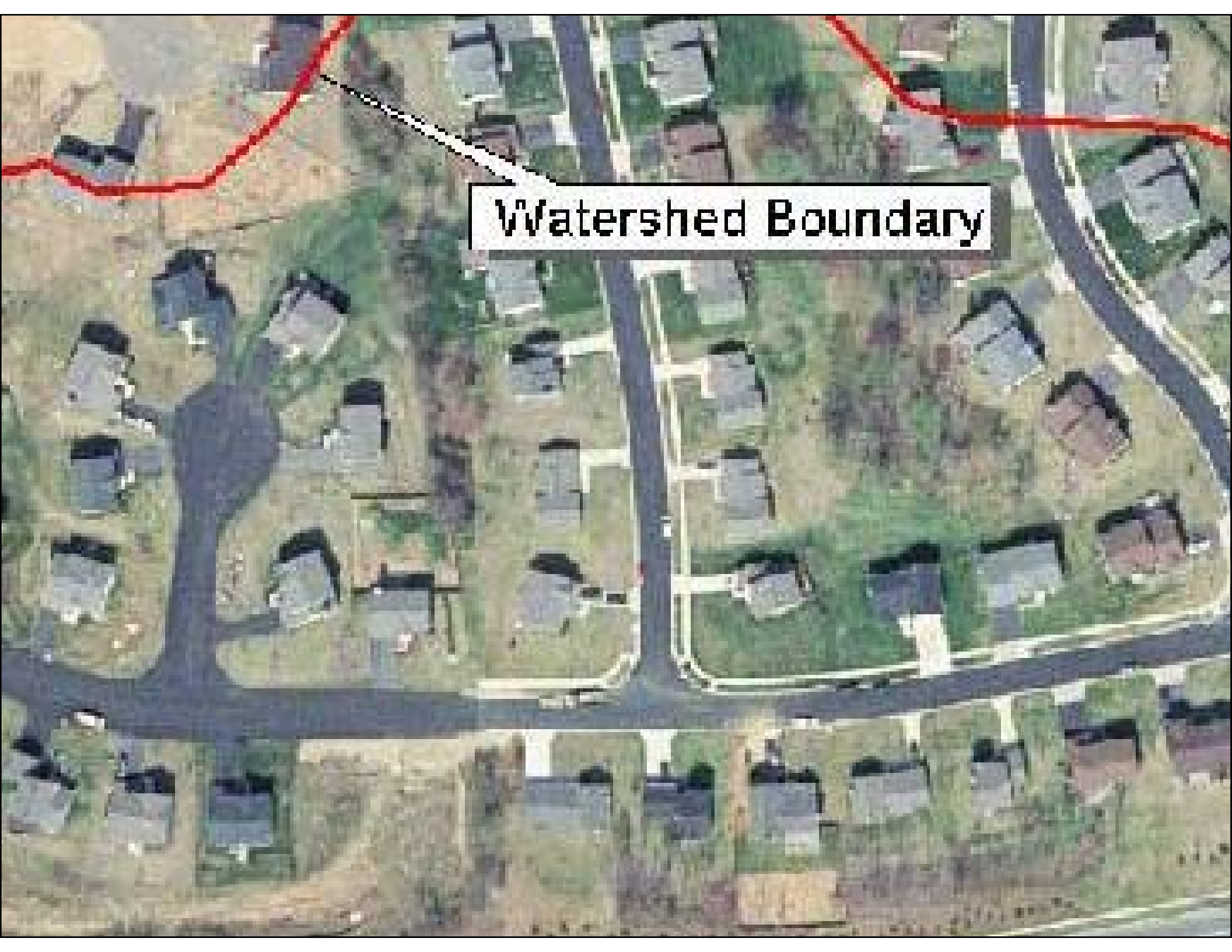


Rain Water Capture and Use



Somerset Subdivision



An aerial photograph of a residential neighborhood. A red line, representing a watershed boundary, runs across the top of the image. A white arrow points from a text box to this line. The neighborhood features several streets, including a main road at the bottom and a curved road on the right. Houses with various roof colors (grey, brown, blue) are scattered throughout, interspersed with green trees and grass. The overall scene is a typical suburban residential area.

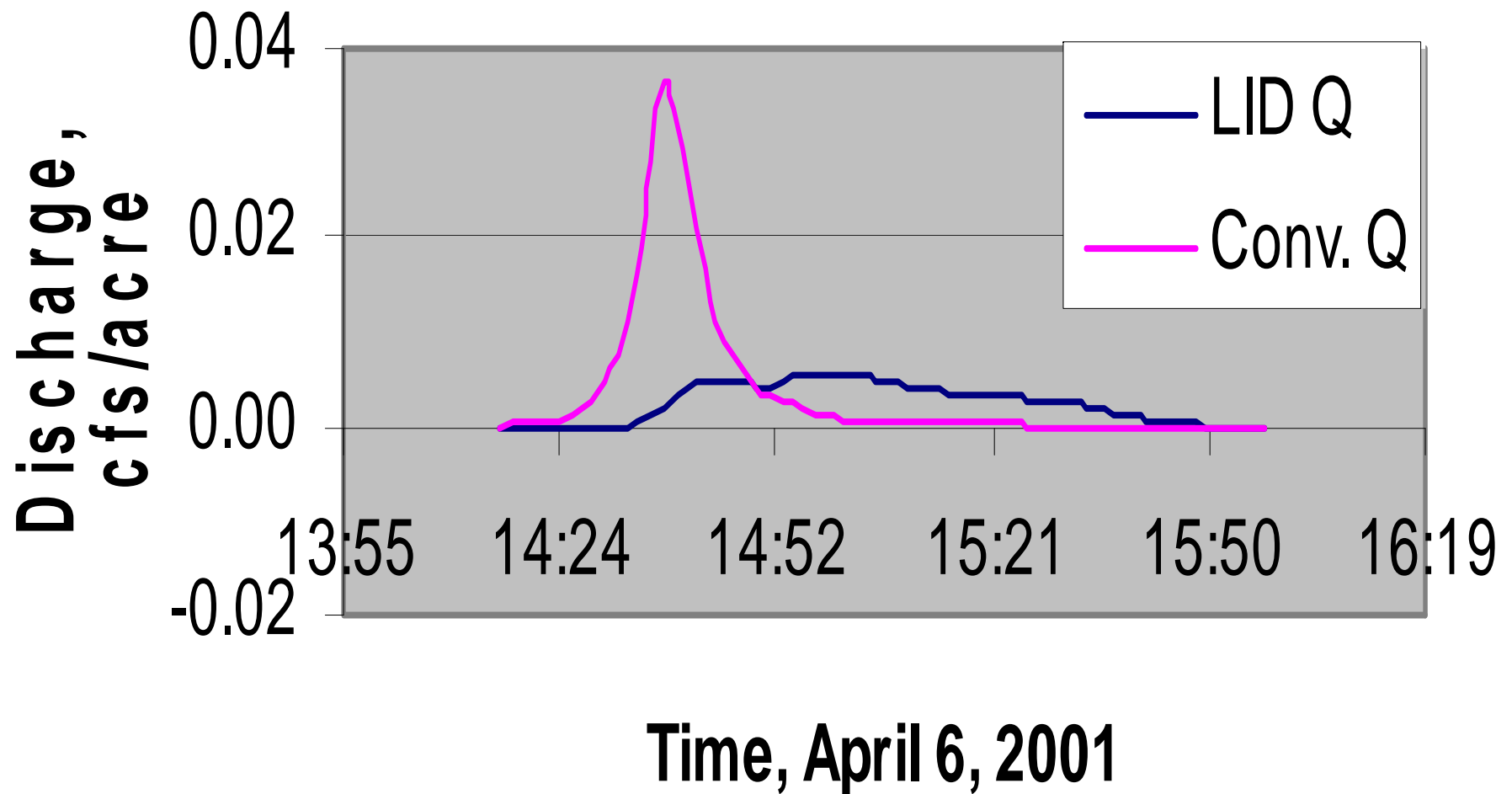
Watershed Boundary

Comparison of Watershed Features

Table 1. Watershed Features

Watershed	Drainage Area (acres)	Number of Houses	Houses/acre	Road Length (ft/acre)	Road Width (ft)	Percent Impervious
Low Impact Development (S2 LID)	11.84	40	3.37 houses per acre	187	36	36 %
Conventional Development (S3 CONV)	8.43	28	3.33 houses per acre	189	24	30 %

Discharge Comparision



Somerset Cost Savings

- \$780,000 Total Cost Savings
 - Eliminated
 - Curb / Gutter \$350,000
 - 4 stormwater ponds \$650,000
 - Pipes / Structures \$150,000
 - Added
 - \$370,000 for Rain Gardens

LID *No* Cost Stuff

- 1. Site Design to Conserve Terrestrial Functions**
- 2. Disconnection**
- 3. Grading Techniques**
- 4. Distributed Controls**
- 5. Multifunctional Use of Space**
- 6. Less Grading and Clearing**
- 7. Reduced Imperviousness**
- 8. Reduced Collection / Conveyance Infrastructure**

Urban Development

Washington D.C.

Potomac
River

Anacostia
River



Urban LID Lot Level Control Opportunities

- Roofs
- Buildings
- Down Spouts
- Yards
- Sidewalks
- Parking Lots
- Landscape Areas
- Open space
- Amended Soils

Multifunctional Infrastructure

Retention

Detention

Filtration

Infiltration

Timing

Water Use

Prevention



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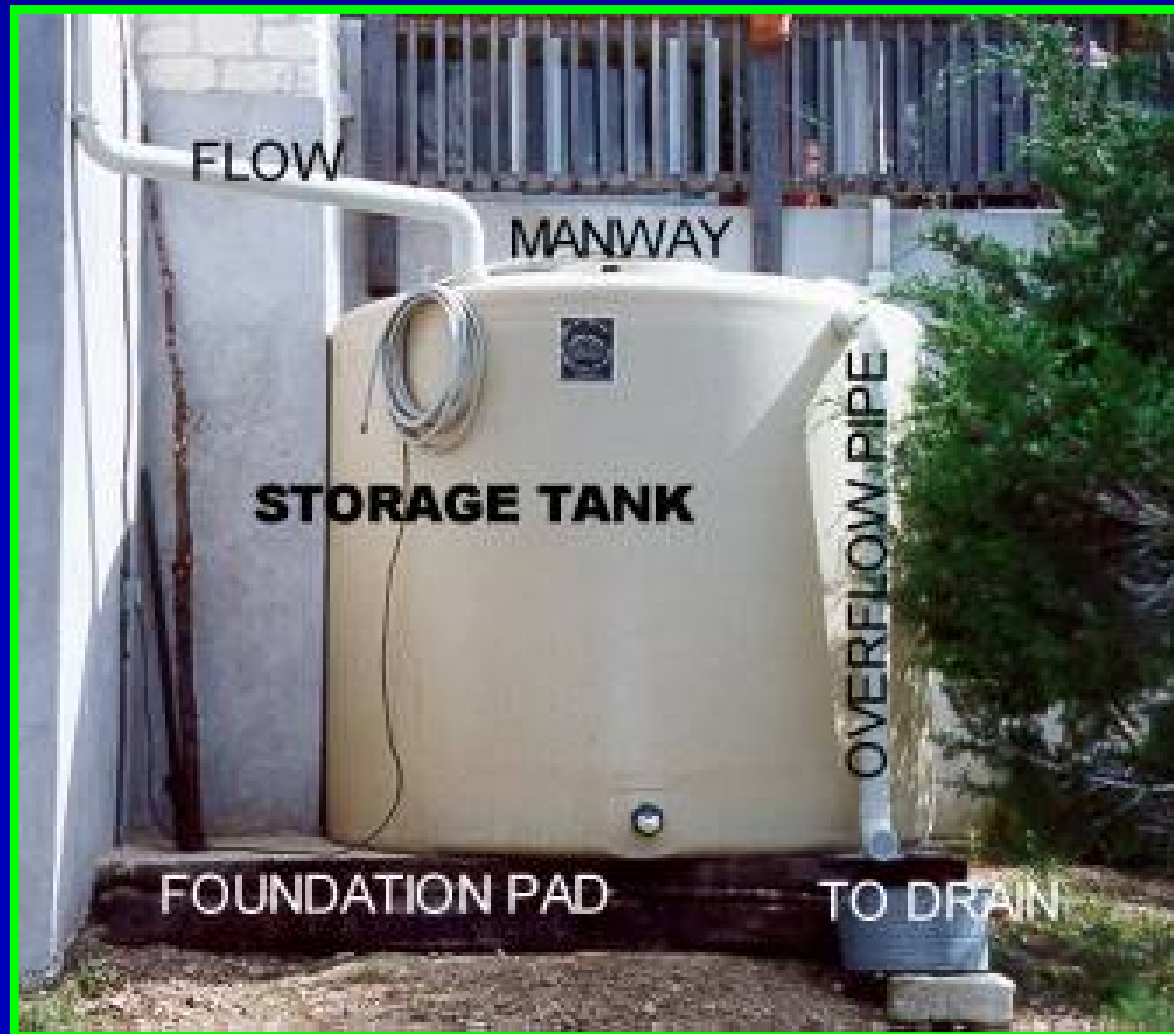
Chicago City Hall after 18 months



Buildings Design



Downspouts Disconnect / Water Use





Rain Garden installed into a planter box on a 100% impervious cover residential mid-rise project in Old Town Alexandria. Roof-drains are within building façade.



Buckman Heights courtyard with infiltration garden

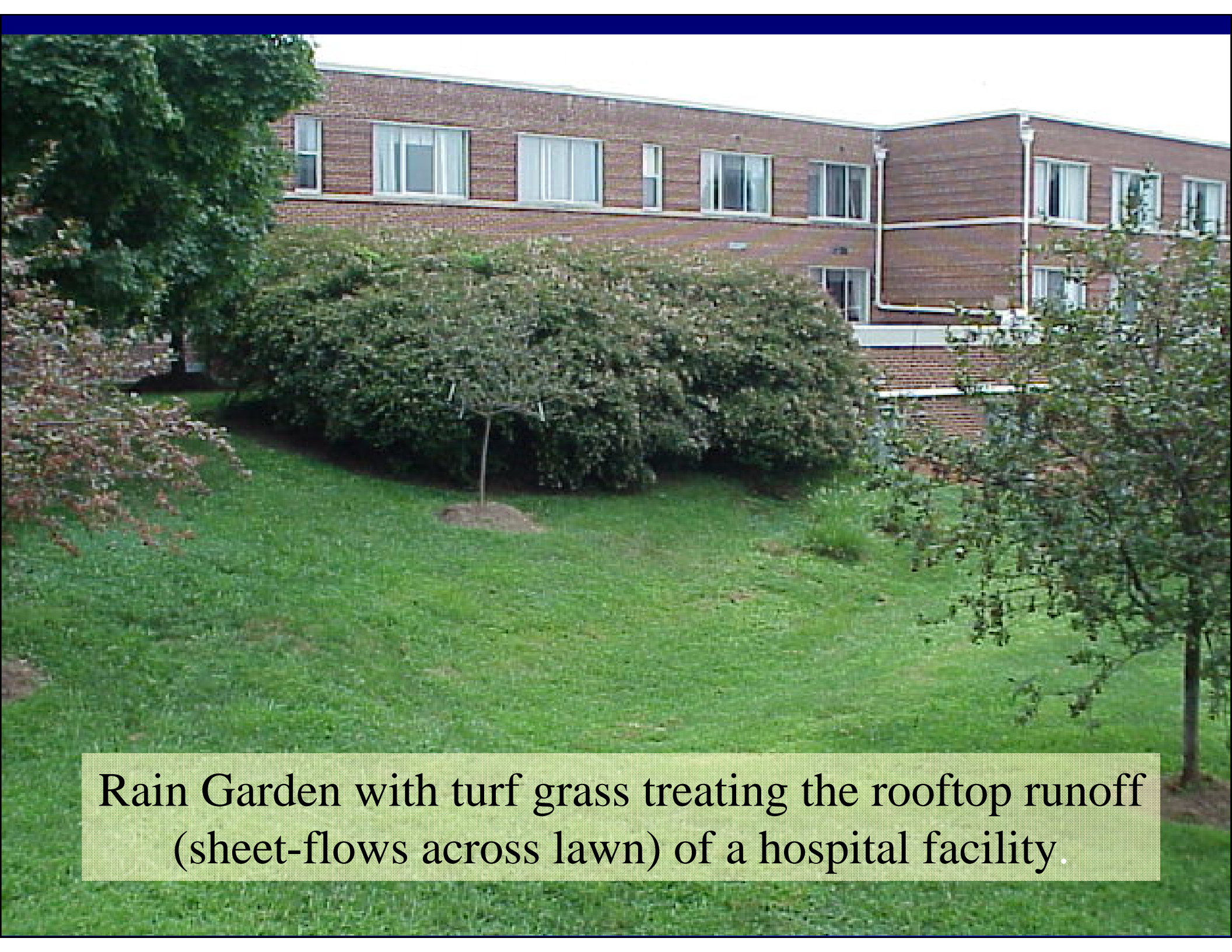


Rain Garden in an office building project along the G.W. Parkway. (Looking East)



A photograph of a rain garden. The central area is covered in green turf grass. To the left, there is a dense, dark green shrub. To the right, there are several trees with green leaves. In the background, a brick building and a parking lot with cars are visible. A semi-transparent text box is overlaid at the bottom of the image.

Rain Garden on a commercial project with turf grass
near I-395 and Edsall Road.



Rain Garden with turf grass treating the rooftop runoff (sheet-flows across lawn) of a hospital facility.



High Flow By-pass

WIN-WILLIAMS
PAINTS





Rain Garden in a median strip of a townhouse project just inside the beltway. Please note the depressed curb and grate inlet structure,

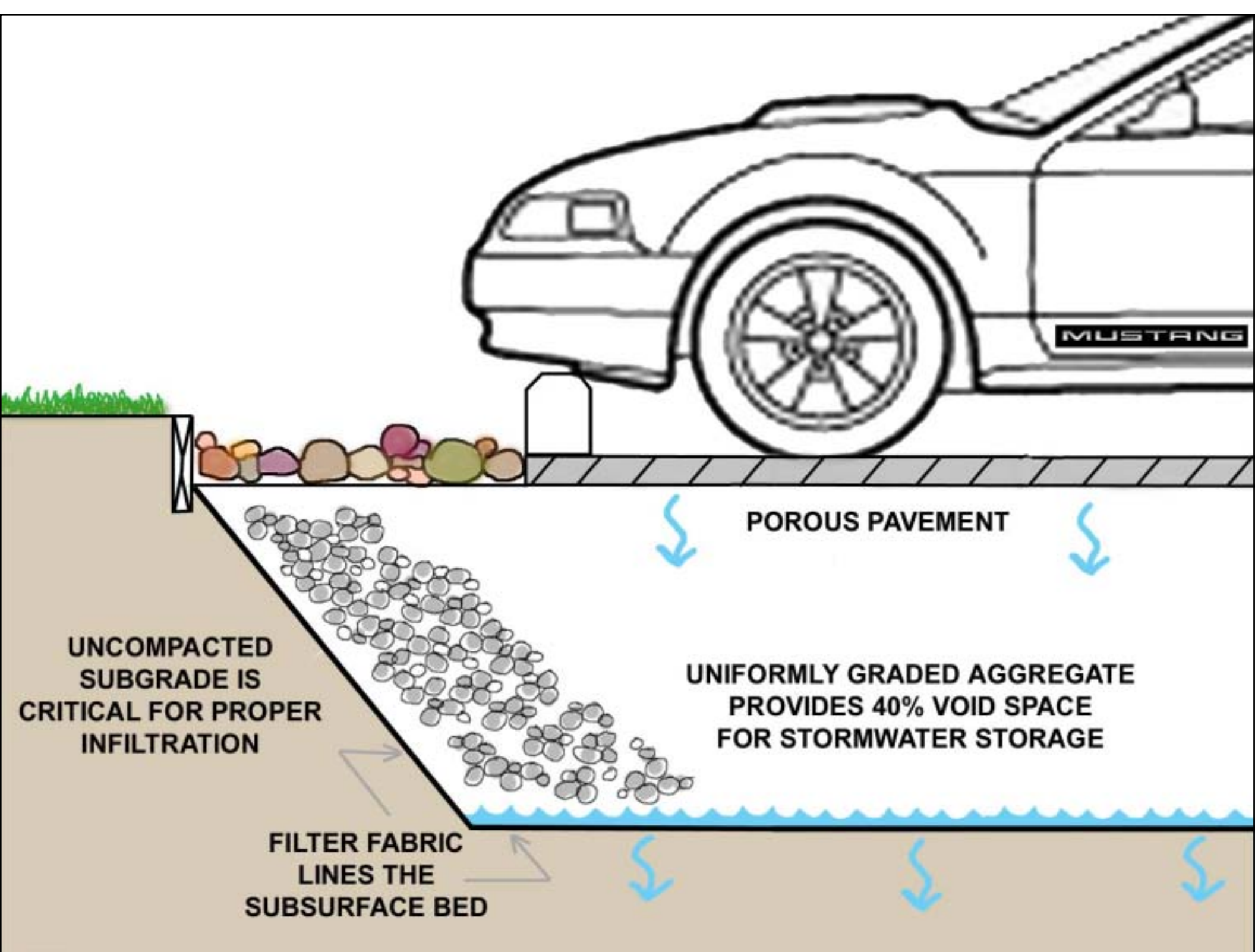


Roadway Bio-swale Maryland



Porous Pavers Washington, DC







Eco-Stone Parking Lot

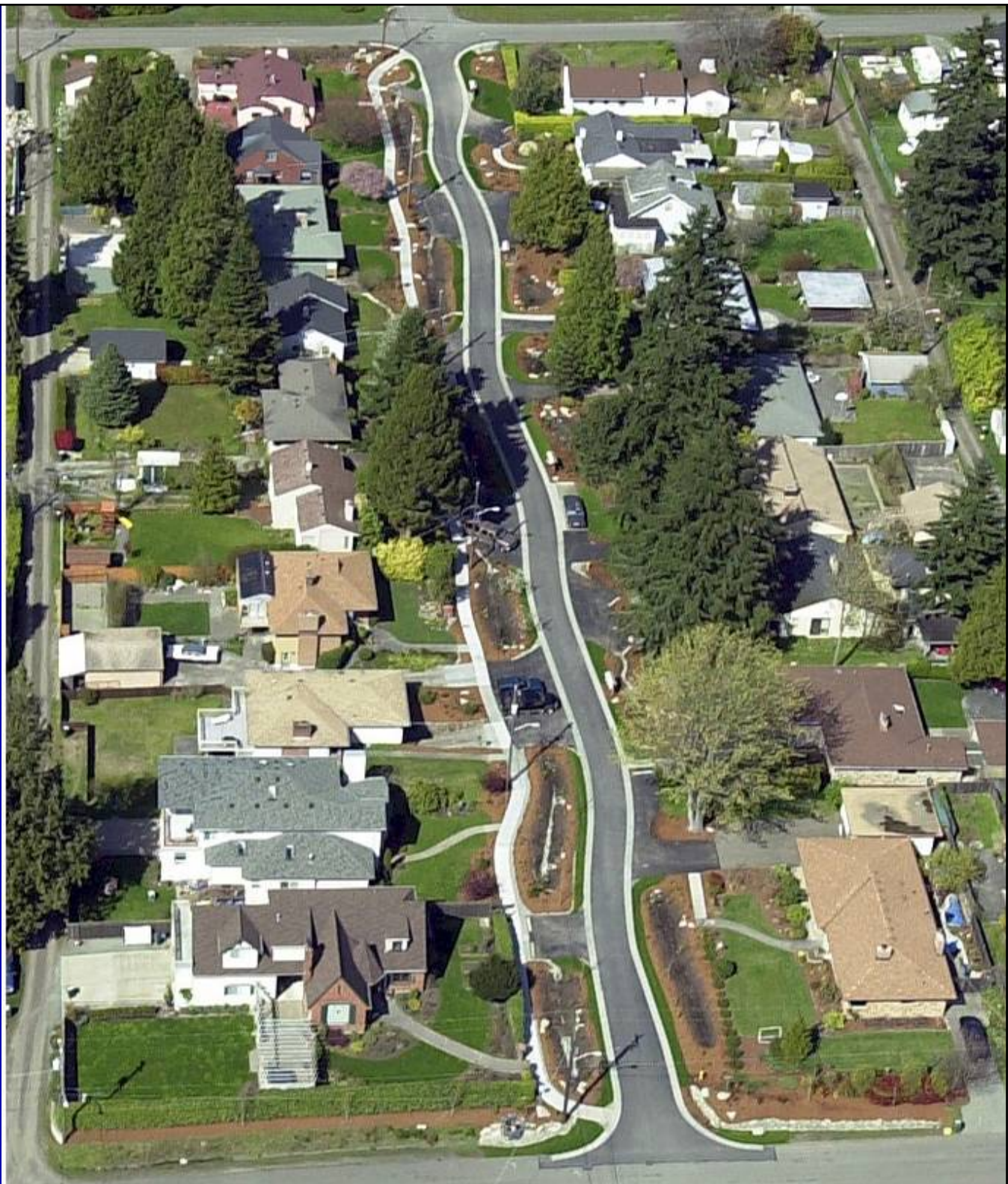
Division Street

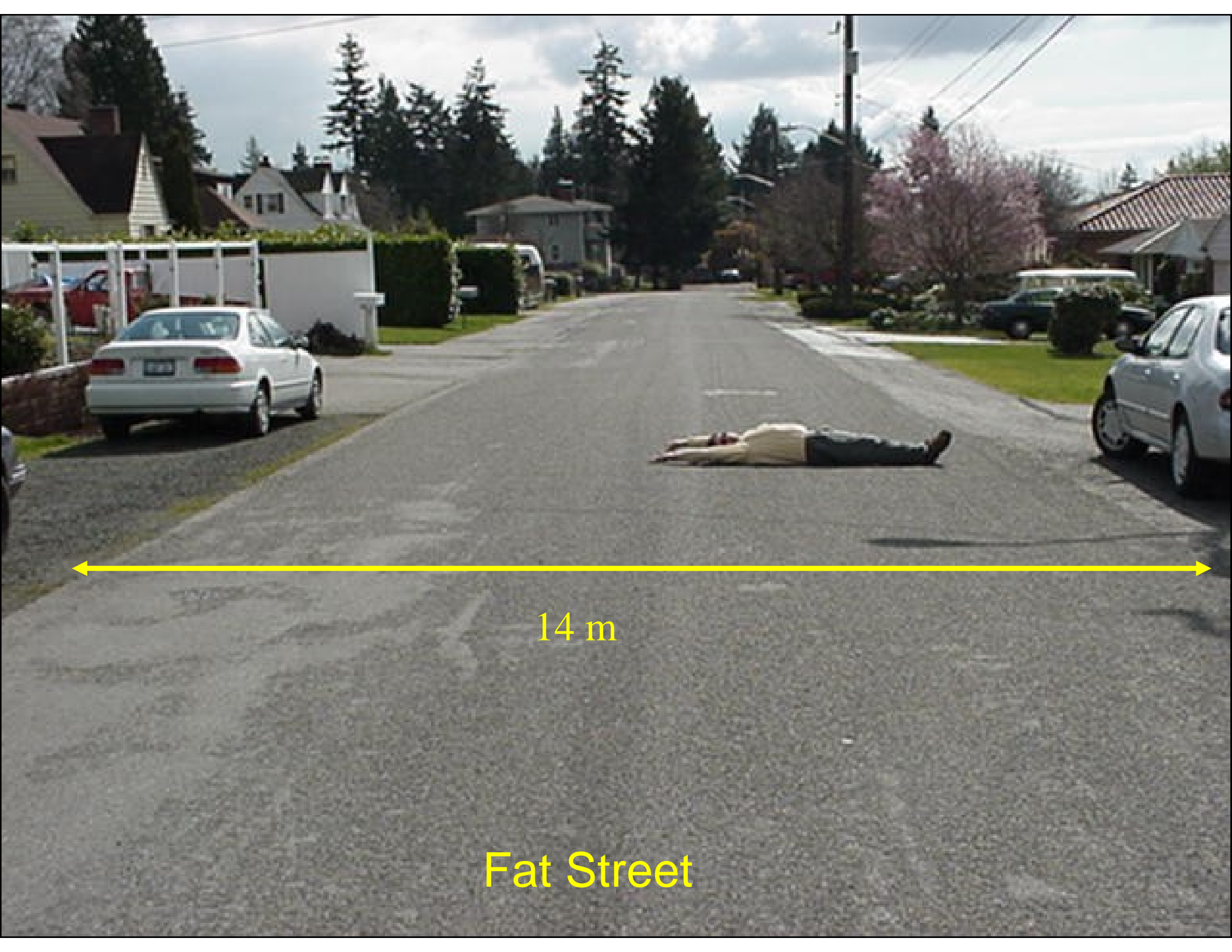
Landscape Planters
in sidewalk area take
Street runoff.
Commercial/Retail zone



Functional Landscape

“SEA”
Street
Seattle,
WA





14 m

Fat Street



Skinny Street with Fat Person



Maximized space for filtration, recharge and landscape elements



